

SECTION 00851
HOT MIX ASPHALT (HMA)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products and procedures for supplying Type I Hot Mix Asphalt (HMA) for overlays placed with a laydown machine and Type II Hot Mix Asphalt (HMA) for overlays placed with a motor grader. HMA comprised of aggregate, asphalt binder, lime and other additives.
- B. Mix materials at a central mixing plant.

1.2 RELATED SECTIONS

- A. Section 00851: Hot Mix Asphalt (HMA)
- B. Section 00850: Asphalt Material
- C. Section 00853: Hydrated Lime
- D. Section 00875: Optional Use of Reclaimed Asphalt Pavement (PG Projects)

1.3 REFERENCES

- A. AASHTO PP 28: Standard Practice for Superpave Volumetric Design for Hot-Mix Asphalt (HMA)
- B. AASHTO T 11: Materials Finer Than 75 Φ m (No. 200) Sieve in Mineral Aggregates by Washing
- C. AASHTO T 19: Unit Weights and Voids in Aggregate
- D. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates
- E. AASHTO T 30: Mechanical Analysis of Extracted Aggregate
- F. AASHTO T 89: Determining the Liquid Limit of Soils

- G. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils
- H. AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
- I. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- J. AASHTO T 112: Clay Lumps and Friable Particles in Aggregate
- K. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- L. AASHTO T 195: Determining Degree of Particle Coating of Bituminous-Aggregate Mixtures
- M. AASHTO T 255: Total Moisture Content of Aggregate by Drying
- N. AASHTO T 304: Uncompacted Void Content of Fine Aggregate
- O. AASHTO T 308: Determining the Asphalt Binder Content of Hot-Mix Asphalt (HMA) by the Ignition Method
- P. ASTM D 4791: Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
- Q. ASTM D 5821: Determining the Percentage of Fractured Particles in Coarse Aggregate
- R. UDOT Materials Manual Part 8
- S. UDOT Minimum Sampling and Testing Guide

1.4 ACCEPTANCE

- A. A lot equals a quantity of HMA between 300 and 3000 tons and may be several days' accumulation.
 - 1. Divide each lot into three approximately equal size sublots.
- B. The Department takes random samples at the roadway.
 - 1. Determine random numbers/locations from a random numbers table UDOT Materials Manual Part 8 Section 981: Random sampling and Testing
 - 2. Obtain samples in accordance with UDOT Materials Manual Part 8 Section 984: Sampling Methods.

- C. The Department takes one random PG binder sample per lot.
 - 1. Sampling Procedure: UDOT Minimum Sampling and Testing Guide, Section 509.
- D. Region Lab personnel perform acceptance tests:
 - 1. Asphalt Binder Content: One per subplot using ignition oven. AASHTO T 308.
 - 2. Aggregate gradation: One test per subplot on the residue of the ignition oven tests. AASHTO T 30.
- E. Central Materials personnel perform the following acceptance tests:
 - 1. Sampling Procedure: UDOT Minimum Sampling and Testing Guide, Section 509.
- F. The Department determines pay adjustment for asphalt content and gradation based on table 1, using the mean of the deviations of the individual test results from the job mix formula and the appropriate sample size column.
 - 1. Applied pay factor is the lowest pay factor for any of the pay sieves or asphalt content.
 - a. Department may order the removal of and no payment made for the HMA if:
 - 1) Any single sieve deviates more than that allowed for 0.85 pay factor.
 - 2) Asphalt content deviates more than that allowed for 0.85 pay factor.
 - b. The Department applies a 0.75 pay factor to HMA allowed to remain in place that is outside the limits of table 1.
- G. The Department reserves the right to sample and test any portion of a day's production for verification purposes. Tests may be performed on any of the parameters used for materials classification or mix design as identified in Part 2: Products.
 - 1. For materials properties, i.e. aggregate, binder, additives, test results that do not meet the minimum requirements as outlined in Part 2 will result in an immediate resample and retest of the lot.
 - a. The Department rejects the lot if the test results of the second sample do not meet minimum requirements.
 - 2. For mix design parameters and aggregate gradations, the Department rejects the lot if the test results fall outside the limits established in table 3.
 - 3. The supplier may initiate a dispute resolution action by following the requirements in Section 02741.

- H. Contractor removes and disposes of any material ordered removed at their expense.
1. Contractor performs or arranges for material removal.
 2. Contractor removes material within ten days of written notice.
 3. Department may remove material after ten days and deduct removal and disposal costs from monies due the contractor.

Table 1 ACCEPTANCE SCHEDULE FOR GRADATION/ASPHALT CONTENT				
<i>Sieve Size</i>	<i>Pay Factor</i>	Mean of deviations of the lot acceptance tests from the job mix (percentage points)		
		<i>5, or more, Tests</i>	<i>4 Tests</i>	<i>3 Tests</i>
Asphalt Content	1.00	0 – 0.38	0 – 0.41	0 – 0.46
	0.975	0.39 – 0.43	0.42 – 0.46	0.47 – 0.52
	0.95	0.44 – 0.47	0.47 – 0.51	0.53 – 0.58
	0.9	0.48 – 0.52	0.52 – 0.56	0.59 – 0.64
	0.85	0.53 – 0.56	0.57 – 0.61	0.65 – 0.69
½ inch	1.00	0 – 0.52	0 – 5.6	0 – 6.3
	0.975	5.3 – 5.8	5.7 – 6.3	6.4 – 7.1
	0.95	5.9 – 6.4	6.4 – 7.0	7.2 – 7.9
	0.9	6.5 – 7.1	7.1 – 7.7	8.0 – 8.7
	0.85	7.2 – 7.7	7.8 – 8.4	8.8 – 9.5
3/8 inch	1.00	0 – 4.9	0 – 5.3	0 – 5.9
	0.975	5.0 – 5.5	5.4 – 5.9	6.0 – 6.6
	0.95	5.6 – 6.1	6.0 – 6.6	6.7 – 7.3
	0.9	6.2 – 6.6	6.7 – 7.2	7.4 – 8.0
	0.85	6.7 – 7.2	7.3 – 7.9	8.1 – 8.9
#4	1.00	0 – 4.8	0 – 5.2	0 – 5.7
	0.975	4.9 – 5.4	5.3 – 5.8	5.8 – 6.3
	0.95	5.5 – 5.9	5.9 – 6.4	6.4 – 6.9
	0.9	6.0 – 6.5	6.5 – 7.0	7.0 – 7.5
	0.85	6.6 – 7.0	7.1 – 7.6	7.6 – 8.0
#8	1.00	0 – 4.0	0 – 4.3	0 – 4.8
	0.975	4.1 – 4.5	4.4 – 4.8	4.9 – 5.4
	0.95	4.6 – 4.9	4.9 – 5.3	5.5 – 6.0
	0.9	5.0 – 5.4	5.4 – 5.8	6.1 – 6.8
	0.85	5.5 – 5.8	5.9 – 6.3	6.9 – 7.4
#200	1.00	0 – 1.7	0 – 1.8	0 – 2.0
	0.975	1.8 – 1.9	1.9 – 2.0	2.1 – 2.2
	0.95	2.0 – 2.1	2.1 – 2.2	2.3 – 2.4
	0.9	2.2 – 2.3	2.3 – 2.4	2.5 – 2.7
	0.85	2.4 – 2.5	2.5 – 2.6	2.8 – 3.0

PART 2 PRODUCTS

2.1 ASPHALT BINDER

- A. Asphalt cement
 - a. Type I (paver placed) – use PG 64-34 asphalt cement
 - b. Type II (grader placed) – use PG 58-22 asphalt cement
- B. Refer to section 00850
- C. Sampling Procedure: UDOT Minimum Sampling and Testing Guide, Section 509.

2.2 AGGREGATE

- A. Crusher processed virgin aggregate material consisting of crushed stone, gravel, or slag.
- B. Use the following requirements to determine the suitability of the aggregate.
 - 1. Coarse aggregates:
 - a. Retained on No. 4 sieve.
 - 2. Fine aggregates:
 - a. Clean, hard grained, and angular.
 - b. Passing the No. 4 sieve.
 - c.
- C. Meet gradation requirements in Table 3. (AASHTO T 11, AASHTO T 27)

Table 2 Aggregate Properties - HMA		
Test Method	Test No.	Requirements
Two Fractured Face	ASTM D 5821	90% min.
Fine Aggregate Angularity	AASHTO T 304	45 min.
Flat and Elongated, 1 to 3 ratio	ASTM D 4791 (Based on 3/8 inch sieve and above)	20% max.
L.A. Wear	AASHTO T 96	35% max.
Sand Equivalent	AASHTO T 176 (Pre-wet method)	50 min.
Plasticity Index	AASHTO T 89 and T 90	0
Unit Weight	AASHTO T 19	75 lb/cu. ft., min.
Soundness (sodium sulfate)	AASHTO T 104	16 % max. loss with five cycles
Clay Lumps and Friable Particles	AASHTO T 112	2% max
Natural Fines		10% max

Table 3 Aggregate Gradations			
Sieve Size		1/2 inch Nominal mix. Percent Passing	3/8 inch Nominal mix. Percent Passing
Control Sieves	3/4 inch	100.0	-
	1/2 inch	90.0 - 100.0	100.0
	3/8 inch	<90	90.0 - 100.0
	No. 4	-	< 90
	No. 8	28.0 - 58.0	32.0 - 67.0
	No. 200	2.0 - 10.0	2.0 - 10.0

2.3 HYDRATED LIME

- A. Use a minimum of 1 percent (by dry weight of aggregate) hydrated lime.
- B. Meet the requirements of Section 00853.

2.4 VOLUMETRIC DESIGN

- A. Comply with all requirements for Superpave Volumetric Mix Design according to Asphalt Institute, SP-1, and SP-2, AASHTO PP 28, Table 5 and the following:
 - 1. Meet all volumetric mix design requirements for a ½ inch nominal target gradation.
- B. Submit the Volumetric Mix Design data for verification at least 10 working days before beginning delivery. Do not begin production until verification is complete.
 - 1. Include all information regarding selection of design aggregate structure showing the target values of percent passing on all sieves listed in Table 3, and the design asphalt binder content.
 - 2. Provide information that aggregate proposed for use meet the requirements of Table 2.
 - 3. Supply QC data for target job mix gradation selection. Use those target values for price adjustments.
- C. Moisture Susceptibility
 - 1. Incorporate hydrated lime into all volumetric designs. Use 1 percent, minimum, for Method A and 1½ percent, minimum for Method B (Section 00853).
- D. Designate asphalt binder supplier.
- E. Use gyratory mixing and compaction temperatures between 295 °F and 310 °F.
- F. The Department Region Materials Lab verifies the Volumetric Mix Design. UDOT Materials Manual of Instruction Part 8-960: Guidelines for Superpave Volumetric Mix Design. The Region Materials Engineer may accept the Volumetric Mix Design from data submitted with the proposed mix design based on a previously verified mix design. The Region Materials Engineer reserves the right to verify any mix design submitted.
- G. Comply with the following requirements for Superpave volumetric mix design:

Table 4 Volumetric Design Gyration				
20 Years Design ESALS (Million)	Compaction Parameters			Voids Filled with Asphalt (VFA) (%)
	N_{initial} /% of G_{mm} *	N_{design} /% of G_{mm} *	N_{max} /% of G_{mm} *	
0.3 to <3	7/# 90.5	75/ ≥ 96.5	115/ # 98	70 - 80

* G_{mm}: Maximum specific gravity of Mix. (Rice Method)

Table 5 Volumetric Design Requirements	
Dust Proportion Range	0.6 - 1.40
Hamburg Wheel Tracker UDOT Materials Manual of Instruction Part 8-990	Maximum 10 mm impression at 20,000 cycles.

- H. Prepare and submit 2 sets (5 samples each) of ignition oven calibration samples.
 - 1. Department uses these samples to determine the correction factors for the Region and Field lab ignition oven.
 - 2. Submit samples a minimum of three working days prior to paving.

2.5 CONTRACTOR INITIATED CHANGES IN MIX DESIGN

- A. Submit all requests in writing at least 12 hours prior to incorporating changes into production.
- B. Submit a field volumetric mix design for all target changes.
 - 1. Field volumetric mix design verification consists of 3 sets of 2 gyratory specimens run at the new target gradation and/or asphalt binder content. Submit documentation substantiating mix was sampled from previous project production.
 - 2. If the field volumetric mix design meets the volumetric requirements, the Region Materials Engineer, provides written concurrence of the verified field volumetric mix design.
 - 3. If the field volumetric mix verification does not meet the volumetric requirements, submit a new laboratory volumetric mix design from a

laboratory qualified by UDOT's Laboratory Qualification Program (LQP).
Allow at least 5 working days for verification.

4. The Department performs up to two volumetric mix design verifications at no cost to the Contractor. The Department charges \$3000 for each additional laboratory and/or field verification required, including all laboratory or field volumetric mix design verifications required due to contractor initiated target changes.
- C. Submit a new laboratory volumetric mix design if changes occur in the aggregate source, asphalt binder source or grade.
- D. Do not make changes to production mix until request is reviewed and verified.

PART 3 EXECUTION

3.1 ADDING HYDRATED LIME

- A. Method A, Lime Slurry; or Method B, Lime Slurry Marination: Refer to Section 00853.

3.2 HMA

- A. Dry aggregate to an average moisture content of not more than 0.2 percent by weight. AASHTO T 255. Adjust burners to avoid damage or soot contamination of the aggregate.
- B. Coat with asphalt binder 100 percent of the particles passing and 98 percent of the particles retained on the No. 4 sieve.
 1. AASHTO T 195.
 2. Discontinue operation and make necessary corrections if material is not properly coated.
- C. Maintain temperature of the HMA between established limits.
 1. Do not overheat the material or cause thermal damage to the asphalt binder.
 2. Department rejects and Contractor removes materials heated over the established limits.
 3. Remove all material rejected by the Department for overheating.

3.3 HMA PLANT

- A. Provide:
 1. Positive means to determine the moisture content of aggregate.
 2. Positive means to sample all material components.

3. Sensors to measure the temperature of the HMA at discharge.
 4. The ability to maintain discharge temperature of the mix in accordance with the mix design.
- B. Asphalt Binder Storage Tanks:
1. Provide calibrated tanks so the quantity of material remaining in the tank can be determined at any time.
 2. Provide a positive means of sampling the asphalt binder from the tanks.
- C. Quality Control Testing
1. Perform all quality control tests necessary to control the production and construction processes applicable to these specifications and listed in the QCP.
 2. Establish a testing program to control as a minimum: asphalt binder content, aggregate gradation, temperatures, and aggregate moisture,
 3. Monitoring: The Department reserves the right to monitor any QC testing.

END OF SECTION